REMARKS/ARGUMENTS

This case has been carefully reviewed and analyzed in view of the Official Action dated 9 April 20070. The undersigned attorney wishes to thank the Examiner for the courtesies extended during the interview held on 23 July 2007. The following remarks provide a record of the substance of that interview.

Responsive to the rejections made in the Official Action and the discussions held during the interview with the Examiner, Claims 1-3, 7, 9, 13, 17-19, 21, 23, 25 and 26 have been amended to clarify the language of thereof. Additionally, Claims 4-6, 14-16 and 20 have been cancelled by this Amendment.

In the Official Action, the Examiner rejected Claims 1-11, 19-21 and 24-26 under 35 U.S.C. § 102(a), as being anticipated by Schleier-Smith, U.S. Patent 6,669,918. The Examiner also rejected Claims 1-16, 18-22 and 24-26 under 35 U.S.C. § 103(a), as being unpatentable over Schleier-Smith. These rejections were essentially a repetition of the rejections made in the prior Office Action.

In order to clarify any misconception the Examiner may have had, as well as any ambiguities present in the claims, one of the co-inventors in both the subject Patent Application and the Schleier-Smith Patent, Dr. James Ellenbogen, was present at the interview and explained the distinctions between the method of Schleier-Smith and that of the subject Patent Application. Dr. Ellenbogen explained the template method of Schleier-Smith and its reliance on random motion of the tubular fullerenes, followed by a discussion of the basis for the

present invention, plus a thorough description of the instant method and apparatus. As discussed at the interview, the calculations that inspired the concepts that formed the basis for the present invention were published in the journal Physical Review Letters. The Examiner asked whether a copy of the published paper had been submitted in an Information Disclosure Statement (IDS). Since that paper is not prior art to the subject Patent Application, the publication of the paper being subsequent to the filing date of the subject Patent Application, it was submitted in an IDS. Therefore, a copy of the Physical Review Letters' published paper is attached hereto as an Appendix, for the Examiner's use (Physical Review Letters, Vol. 92, No. 8, 27 February 2004, pg. 085503-1 - 085503-4.)

Following Dr. Ellenbogen's presentation, the Examiner stated that he understood what constituted the invention, but noted that the claim language did not clearly express the inventive method and apparatus. The Examiner requested that the clarifying language was required with respect to such elements as the substrate, the lattice structure, the alignment of the tubular fullerenes, and the tubular fullerenes not adsorbed on the substrate.

Accordingly, the invention of the subject Patent Application, as now defined in Claim 1, is directed to a method for bulk separation of single-walled tubular fullerenes based on helicity. The method includes the step of providing in a fluid a plurality of single-walled tubular fullerenes being of a multiplicity of different helicities. Each of the plurality of single-walled tubular fullerenes has a

longitudinal axis. The method includes the step of providing a crystalline substrate having an upper surface whose atomic lattice structure, in a plane of the upper surface, provides at least one energetically favored angular orientation of the longitudinal axis of the single-walled tubular fullerenes with respect to an axis of said lattice structure. Thus, by the aforesaid angular relationship single-walled tubular fullerenes of one helicity are adsorbed to the upper surface of the substrate in preference to single-walled tubular fullerenes of other helicities.

The method of Claim 1 further includes the step of establishing a flow of the fluid for transporting the plurality of single-walled tubular fullerenes with the longitudinal axes thereof in substantially parallel relationship, one with respect to another, and substantially aligned with a direction of the flow of the fluid. Still further, the method includes directing the flow of the fluid containing the plurality of single-walled tubular fullerenes in parallel with the upper surface of the substrate and in contact therewith to pass into an effluent receiver disposed adjacent to a perimeter of the substrate. The flow is in the at least one energetically favored angular orientation to thereby preferentially adsorb and hold the single-walled tubular fullerenes of the one helicity to the upper surface of the substrate. Additionally, the method includes removing the single-walled tubular fullerenes held to the upper surface of the substrate.

From another aspect, as defined in Claim 19, the invention of the subject Patent Application is directed to a system for bulk separation of single-walled

tubular fullerenes based on helicity. The system includes a container of a fluid bearing single-walled tubular fullerenes. The single-walled tubular fullerenes are of a multiplicity of different helicities, and each of said single-walled tubular fullerenes has a longitudinal axis. The system includes a dispensing assembly having at least one outlet for discharging the fluid bearing single-walled tubular fullerenes in a directed flow, and at least one inlet coupled in fluid communication with the container and spaced from the outlet. The dispensing assembly includes means for aligning the longitudinal axes of the single-walled tubular fullerenes in substantially parallel relationship and in a direction of the directed flow of the fluid. The system for bulk separation further includes a crystalline substrate having an atomic lattice structure with an axis defined in a plane of an exposed upper surface thereof. The outlet of the dispensing assembly is positioned with respect to the substrate for the directed flow of the fluid to be in parallel with the upper surface of the substrate and in contact therewith. By that arrangement, the axis of the atomic lattice structure is disposed in a predetermined angular relationship with respect to the directed flow of the fluid from the at least one outlet of the dispensing assembly. The angular relationship is selected to favor energetically the adsorption of the single-walled tubular fullerenes of one helicity in preference to single-walled tubular fullerenes of other helicities. The energetically favored adsorption is sufficient to hold the single-walled tubular

fullerenes of the one helicity to upper surface of the substrate, as the fluid bearing single-walled tubular fullerenes flows across the upper surface of said substrate. Still further, the system includes a drainage assembly disposed adjacent to a portion of the substrate distal from the dispensing assembly for receiving any of the fluid bearing single-walled tubular fullerenes not held on the upper surface of the substrate.

It is believed that the claims now clearly define the spatial relationships between the axes of the tubular fullerenes, the axes of the tubular fullerenes and the fluid flow, the direction of fluid flow and the axis of the atomic lattice structure in the plane of the upper surface of the crystalline substrate, and the fluid flow with respect to the surface of the substrate (i.e. in parallel and in contact therewith). Further, the substrate has been more clearly defined as being a crystalline substrate having an atomic lattice structure in a plane of the upper surface of the substrate that provides at least one energetically favored angular orientation of the longitudinal axis of the tubular fullerenes with respect to an axis of the lattice structure for the tubular fullerenes of one helicity to be adsorbed thereto in preference to tubular fullerenes of other helicities. Additionally, the fluid flow has been clarified as passing into an effluent receiver disposed adjacent to a perimeter of the substrate. These and other clarifications made to the claims are believed to address the issues raised by the Examiner at the interview.

With respect to the rejections made in the Office Action, the aforesaid method and structure is in contradistinction to the Schleier-Smith reference. The reference is directed to a method for bulk separation of single-walled tubular fullerenes based on chirality which relies on a template 40 to achieve the selective separation of the tubular fullerenes. As clearly shown in Fig. 3b of the reference, the surface of the substrate 30 of the template 40 is only exposed in the narrow elongated openings 32. The openings 32 extend at an angle with respect to the substrate lattice axis which is the "locking angle" (angle that energetically favors adsorption) for the tubular fullerenes of a selected chirality. Thus, when the template is exposed to a suspension of fullerenes having random chiralities, the tubular fullerenes of the selected chirality will be adsorbed at the elongated opening sites 32, while tubular fullerenes of other chiralities are not adsorbed to the template.

If the template is simply submerged in the suspension of fullerenes, whatever "flow" occurs will be a random flow, and there is no disclosure of effluent receiver disposed in relationship to the template. Therefore, the reference does not provide for directing the flow of the fluid containing the plurality of single-walled tubular fullerenes the in parallel with the upper surface of the substrate and in contact therewith to pass into an effluent receiver disposed adjacent to a perimeter of the substrate, the flow being in the at least one energetically favored angular orientation to thereby preferentially adsorb and hold

the single-walled tubular fullerenes of the one helicity to the upper surface of the substrate, as now claimed. Further, where the reference discloses an electrodeposition process (column 4, lines 48-61), the resulting "directed flow" is orthogonal to the plane of the substrate and therefore neither discloses nor suggests a directed flow in parallel with said upper surface of said substrate and in contact therewith to pass into an effluent receiver disposed adjacent to a perimeter of said substrate, and the that orthogonal flow is not in at least one energetically favored angular orientation with respect to the axis of the atomic lattice structure in a plane of the upper surface of the substrate, as now claimed.

The Schleier-Smith reference neither discloses, nor inherently possesses, nor suggests that one could separate single-walled tubular fullerenes based on chirality by directing a flow of the fullerenes across the surface of the template at any particular angle. At the time of the Schleier-Smith invention, it was not known in the art, nor to the Inventors, the dramatic increase in magnitude of the attractive force between the tubular fullerenes and the lattice of the substrate at the "locking angle". That lack of knowledge is evidenced by the use of the electrodeposition process, using electro-dynamic forces to "propel" the tubular fullerenes downwardly into contact with the template. It was not until the Inventors of the subject Patent Application proceeded to perform the very difficult analysis and calculations necessary to determine the interactive energy between the nanotubes and the substrate lattice, the results of which are shown in Fig. 4,

and subsequently published in Physical Review Letters, Vol. 92, No. 8, 27 February 2004, that use of directed flow was even contemplated as a possible means of achieving separation of nanotubes based on chirality.

The Schleier-Smith reference does not disclose any apparatus that includes a dispensing assembly having at least one outlet for discharging the fluid bearing single-walled tubular fullerenes in a directed flow and at least one inlet coupled in fluid communication with the container and spaced from the outlet, the dispensing assembly including means for aligning said longitudinal axes of the single-walled tubular fullerenes in substantially parallel relationship and in a direction of the directed flow of the fluid, as now claimed. Nor does the reference disclose the outlet of the dispensing assembly being positioned with respect to the substrate for the directed flow of the fluid to be in parallel with the upper surface of the substrate and in contact therewith, wherein the axis of the atomic lattice structure is disposed in a predetermined angular relationship with respect to the directed flow of the fluid from the at least one outlet of the dispensing assembly, the angular relationship being selected to energetically favor adsorption of the single-walled tubular fullerenes of one helicity in preference to single-walled tubular fullerenes of other helicities, the energetically favored adsorption being sufficient to hold the single-walled tubular fullerenes of the one helicity to the upper surface of the substrate as the fluid bearing single-walled tubular fullerenes flows across the upper surface of the substrate, as now claimed. Still further, the reference

fails to disclose a drainage assembly disposed adjacent to a portion of said substrate distal from said dispensing assembly for receiving any of said fluid bearing single-walled tubular fullerenes not held on said upper surface of said substrate, as now claimed. Therefore, the Schleier-Smith reference cannot anticipate or make obvious the invention of the subject Patent Application. Further, as the reference fails to suggest such a combination of elements, and in fact teaches away from that combination, it cannot make obvious that invention either.

It is believed that the rejections made with respect to the independent and dependent claims were the result of a misunderstanding of the inventive concepts defined by those claims, the misunderstanding being the result of claim language that contained ambiguities. The ambiguities were identified at the interview with the Examiner and are believed to now have been removed by this Amendment, thereby clarifying the method and apparatus of the invention of the subject Patent Application.

For all the forgoing reasons, it is now believed that the subject Patent Application has been placed in condition for allowance, and such action is respectfully requested.

Respectfully submitted,
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